

TABLE OF CONTENTS

Z10 General Requirements for All Disciplines (Programmatic and Facility)

Z10	GENERAL REQUIREMENTS FOR ALL DISCIPLINES (PROGRAMMATIC AND FACILITY)	2
1.0	DEFINITIONS	2
Z1010	ADMINISTRATION	2
1.0	BACKFIT	3
2.0	CODES AND STANDARDS.....	3
3.0	“CONFLICTS” AND ADEQUACY	4
4.0	“CONSTANTS”	5
5.0	DESIGN SUBMITTALS	5
6.0	GRANDFATHERING.....	6
7.0	ENVIRONMENTAL CONSIDERATIONS.....	7
8.0	EQUIPMENT IDENTIFICATION	7
9.0	EQUIPMENT LOCATION	8
10.0	PROGRAMMATIC APPLICABILITY	8
11.0	RENOVATIONS/UPGRADES	8
12.0	SPECIFICATIONS	8
13.0	VARIANCES	9
Z1040	PROJECT CLOSEOUT	10

REVISION RECORD

Rev	Date	Description	POC	OIC
0	XX/XX/X	Initial issue.	Tobin H. Oruch, <i>FWO-DO</i>	Gurinder Grewal, <i>FWO-DO</i>

Z10 GENERAL REQUIREMENTS FOR ALL DISCIPLINES (PROGRAMMATIC AND FACILITY)

1.0 DEFINITIONS

consider	<p>When used in a guidance (<i>italicized</i>) statement, it is suggesting the designer look at and think about following the guidance offered, and not dismiss out of hand.</p> <p>When used in a requirement statement, the intent is the same. Good practice is to document the thought process of this consideration, particularly when rejecting the suggestion partially or wholly. In some cases in the ESM, documentation is specifically required (e.g., design notes or memo to file); in other cases, submittal of such documentation for approval is required.</p>
Contractor	The entity performing the work. This may be the SSS, another contractor, or an M&O employee. Used in specifications and elsewhere.
CSI format Specifications	The numbering and 3-part format defined by the Construction Specifications Institute's MasterFormat and SectionFormat documents (see LCSM below).
ESM	Engineering Standards Manual (OST220-03-01-ESM)
LCSM	LANL Construction Specifications Manual (OST220-03-01-CSM). These CSI numbered/formatted specifications address construction-type work and maintenance (two examples: piping repairs and testing, carpet and other like-for-like replacements).
M&O	Management & Operating, as in the prime contractor running LANL (e.g., UC)
POC	Point-of-Contact
SSS	Support Services Subcontractor (KSL at time of writing)
temporary	When used in conjunction with office or other trailer installations, temporary is defined as less than 3 years. Other ESM Chapters may define temporary as a shorter timeframe for the purpose of establishing when aspects of those chapters apply for safety reasons (e.g., <i>Electrical Chapter 7, 90 days; Mechanical Chapter 6, 180 days</i>)

Z1010 ADMINISTRATION

Where appropriate, guidance is provided to aid the cost-effective implementation of site-specific requirements and the requirements in the applicable codes. *Italicized* text identifies recommended guidance (not mandatory), based on good business practice and through lessons-learned at LANL. All other text in regular type indicates **mandatory** requirements unless prefaced with wording identifying it as guidance or a recommendation.

1.0 BACKFIT

- A. When an existing SSC is upgraded to Safety Significant/ML-2 or Safety Class/ML-1, the system owner shall perform a formal backfit analysis. The process shall determine if the SSC complies with the current standards or establish the feasibility and cost effectiveness of redesigning the SSC to comply with current standards. If the process finds the design complies with current standards, the analysis shall be submitted to the Design Authority for review and approval. If redesign is found to be necessary, feasible, and cost effective, the design agency shall commence design activities utilizing the current standards. If redesign is found not to be necessary, feasible or cost effective, the system owning division shall submit for a variance to the ESM requirements in accordance with [LIR 301-00-02](#), Variances and Exceptions to Laboratory Operations Requirements.

2.0 CODES AND STANDARDS

- A. Comply with the applicable portions of the latest edition and addenda of each code and standard in the ESM, others as applicable, and those in the LANL contract (*including Appendix G and the Work Smart Standards [WSS] listing*).
<http://labs.ucop.edu/internet/comix/>

Guidance: A few of the WSS listings of general interest are:

International Building Code, latest edition

NFPA codes and standards, latest edition (with some exceptions)

DOE Order 420.1A, Facility Safety (with some exceptions)

- B. Follow all applicable Codes of Federal Regulation (CFRs), latest edition. *These are federal agency requirements that have the force of law.*
http://www.lanl.gov/f6stds/pubf6stds/engrman/pdf/Rules_Orders-03.pdf
- C. For national and DOE standards, in general, if a standard is required, then its “shall” statements must be followed if applicable – but “should” statements need not be followed to be in conformance with the standard. If, however, the ESM or LCSM mandates non-mandatory sections of national/DOE-type standards, then those sections become required for LANL work.
- D. **Online Codes and Standards:** Access to selected online national codes and standards are available to anyone with a LANL IP address or “smart card” at:
<http://lib-www.lanl.gov/infores/stand/stanihs.htm>

2.1 LANL Engineering Standards

- E. Engineering Standards Manual (ESM), OST220-03-01-ESM¹

Guidance: This chapter’s section number (Z10) follows the UNIFORMAT system promulgated by the Construction Specifications Institute (CSI) and further described in ASTM E1557.

Comply with standard detail drawings in the ESM unless referenced in italicized text. Edit the details to reflect the particular details of the project, but do not delete applicable requirements (portions that in no way apply) without ESM Discipline POC approval.

- B. Construction Specifications Manual, OST220-03-01-CSM (Specification sections applicable to Programmatic work are clearly identified in the ESM or that manual).
 - 1. Comply with the LANL Construction Specifications Manual (LCSM) when writing and preparing a specification package, i.e., format, writing and editing, etc. Guidance: The LCSM provides construction specifications that are referenced throughout the ESM. Specifications are preferred over extensive drawing notes.
 - 2. Number the specification sections in accordance with the CSI MasterFormat document.
 - 3. Comply with specifications in the ESM unless referenced in italicized text. When editing these specifications to suit the project, add job-specific requirements and delete only those portions that in no way apply. To seek a variance from applicable requirements, contact the ES discipline POC.
- C. Drafting Manual, OST220-03-01-DM
 - 1. Comply with the LANL Drafting Manual when creating or revising drawings for facility projects. Guidance: This manual does not address weapons design work covered by ESA Division procedures. *Use of the LANL Drafting Manual is recommended for programmatic work.*
- D. *Guidance: The LANL Standards are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system. The design organization is responsible for providing a complete design package.*

The above manuals are available at: <http://www.lanl.gov/f6stds/pubf6stds/xternhome.html>

3.0 “CONFLICTS” AND ADEQUACY

- A. Where requirements are present in other ESM chapters, follow them as well as any herein. Having a requirement in one but not both locations is not a conflict and the most stringent shall be followed.
- B. Similarly, having a requirement in one place and a guidance statement in another place that is similar or addressing the same issue is not a conflict and the requirement shall be followed (this is often intentional – practicing technique of having directive in one/best place and referring to it or reiterating it elsewhere; an example is 2.0.A “guidance” above).
- C. In the case of actual conflicting requirements, the other chapters supercede this one except where specifically noted herein. The Chapter 1 Point-of-Contact has authority to resolve issues.
- D. If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so comply with the most stringent requirements among the LANL documents.

- E. The adequacy of all design inputs is the responsibility of the designer/design agency. If the designer believes the ESM to be incorrect (e.g., compliance will cause a problem), it is their responsibility to bring the issue to the attention of the ESM Discipline POC (via the Project Manager if appropriate) for resolution.

4.0 “CONSTANTS”

Following are “constants” to be used for most design at LANL. These are generally conservative; however, when other ESM chapters contain other constants, they take precedence [NOTE: there may be instances where these values are not conservative; then, conservative or actual values are required].

- A. Altitude: 7500 feet (known exceptions: (1) design “clean” fire extinguishing agents using a design altitude no higher than actual per ESM Chapter 2 and LCSM Section 13967; (2) for TA-57 Fenton Hill site, use 8600 feet and adjust all HVAC requirements/guidance accordingly).
- B. Latitude: 35.6 N.
- C. Barometric Pressure: 11.10 psia (22.65 inches Hg).¹
- D. Air Density (7,500 feet): 0.057 pcf (0.075 at standard air)²
- E. Air Density Ratio: $0.075/0.057 = 1.32$ (Reciprocal = 0.76)

5.0 DESIGN SUBMITTALS

- A. Design Criteria Drawing Data (new buildings and additions): Provide information on a drawing that captures the codes of record (i.e., the major national code and standard and LANL standards followed, including edition). Follow the LANL Drafting Manual for Drawing sheet and format (e.g, Section 214). *As an example of codes and standards listing: NEC-2002, IBC-2003 (Group B), LANL ESM I&C Chapter 8 Rev1, etc., etc. An example is being developed.*
- B. Architectural Code Reference/Analysis Drawing Data (new buildings and additions): Provide information on a drawing that captures the architectural code analysis. Addresses codes/editions followed, occupancy group, occupant number assumptions and limits, egress analysis, etc. Follow the LANL Drafting Manual for Drawing sheet and format (e.g, Section 214). *(more detailed requirements and an example may appear Architectural Chapter in the future). An example is being developed.*
- C. Sealing: Comply with the New Mexico Engineering and Surveying Practice Act (Chapter 61, Article 23 NMSA 1978). All drawings, specifications, calculations, and reports prepared by consultants or contractors that are involved in the practice of engineering shall bear the seal and signature of a professional engineer, currently licensed in New Mexico, in responsible charge and directly responsible for the engineering work.³
 - 1. The PE shall only stamp those discipline drawings for which he is in responsible charge and directly responsible for the engineering work, and none for which he is not.

2. Architectural: Follow the requirement above except that such documents must bear the seal of a registered architect per the NM Architectural Act based on Article 15 of same Act.
3. Exceptions: As stated in specific chapters; however, having more stringent requirements anywhere is not a conflict and the most stringent shall be followed.
4. Other exceptions: Fire detection and alarm system design/shop drawings prepared by factory-qualified, NICET Level-III-certified fire alarm contractors need not be sealed ([National Institute for Certification in Engineering Technologies](#)).
5. LANL management & operating contractor (M&O, e.g., UC) employed engineers, performing engineering services involving the operation of LANL, on LANL property, are exempt from the licensing requirements of the New Mexico Engineering and Surveying Practice Act.⁴
6. SSS employees shall follow the Act and seal design beginning October 1, 2004.⁵
7. When the design output takes the form of a Design Change Package or Engineering Change Notice, those packages shall be stamped in a manner similar to a drawing package per the requirements above.
8. Guidance: Sealing as-built drawings is not required.⁶

6.0 GRANDFATHERING

- A. Projects are generally not required to comply with new or revised LANL Engineering Standards issued after they are “underway.” The definition of underway and additional discussion is contained in [LIR 220-03-01, Engineering Standards](#).
 1. *Guidance: For the AE or design-builder, LANL Supply Chain Management Division contract provisions specify that the required standards for a project are those in effect on the date of the solicitation unless the Request for Proposal specifically invokes a different set.*
 2. *Guidance: It is often to a project’s advantage to voluntarily adopt newer standards during design. Newer standards incorporate lessons learned for safety, cost effectiveness, and overseer expectations. Newer specs have updated product information and logistical information for working at LANL. In both cases, these can smooth the design, construction, start-up, and operation phases.*
- B. **Codes of Record:** The codes and standards in effect when a facility design commences are considered the “codes of record” and often remain in effect for the life of the facility. Establishment and maintenance of the facility’s design basis, including “codes of record” shall be in accordance with LIR 240-01-01, Facility Configuration Management. As determined by the Design Authority (System Engineer’s management) and the applicable ES POC, the codes of record can be applied to later modifications, replacements, or rehabilitation less than 50% of the estimated replacement value when justifiable (when greater than 50%, the system shall be upgraded to current standards).

7.0 ENVIRONMENTAL CONSIDERATIONS⁷

- A. The requirements identified within this section are for safety-related SSCs or those systems that provide a mission critical, defense in depth, or worker safety function or whose failure may impact the operation of safety-related SSCs. For other non-safety systems, all items in this section shall be interpreted as guidance that establishes sound engineering practice for the proper and reliable performance of such SSCs.

7.1 General

- A. The environmental conditions in which equipment must operate or which can affect the proper or continued operation of equipment shall be clearly identified and considered in design and equipment selection. Normal ambient, abnormal operating, climatic and event conditions shall be evaluated in the identification of applicable environmental conditions.

Guidance: The environmental factors that should be considered when selecting equipment location or equipment for a location include, but are not limited to, the following:

- Temperature and/or Humidity Extremes
- Barometric Pressure Variations
- Airflow
- Corrosive Atmospheres
- Area Flooding
- Acoustic Noise
- Electronic Noise, or Electromagnetic Interference (EMI)
- Power Supply Quality (electrical surges, frequency variations, etc.)
- Grounding
- Lighting
- Lightning Protection
- Physical Security
- Vibration
- Interference from Large Motors and Power Feeders
- Chemical and Particulate (dust) Contamination
- Radiation
- Elevation above sea level

8.0 EQUIPMENT IDENTIFICATION

- A. Identify major equipment in accordance with the nomenclature indicated in LANL Engineering Standards Manual, [Chapter 1](#), Section 230, Component Nomenclature.
- B. Label equipment in accordance with ESM Chapter 1, Section 240, Labeling (future), LANL [Construction Specification](#) 15075, Mechanical Identification, and LANL Construction Specification 16195, Electrical Identification as applicable.⁸

9.0 EQUIPMENT LOCATION

- A. Equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction, as required by code and as recommended by the manufacturer.⁹
 - 1. If safety-related equipment is not accessible with a man-lift or rolling platform, provide permanent OSHA compliant structures for access to equipment installed 12 feet or higher above finished floors (e.g., controllers, transmitters, valve/damper actuators, etc).¹⁰ Guidance: This requirement should be considered, not only for safety-related equipment, but for any component that is located 12 feet or higher, especially if frequent inspections are necessary.

10.0 PROGRAMMATIC APPLICABILITY

- A. The ESM shall be applied to programmatic systems and components as follows:
 - 1. Headings in ESM chapter sections followed by “Programmatic and Facility” or a bold capital “P” or “P&F” indicates that subsection shall be complied with by all of LANL, including programs.
 - a. *Guidance: Programmatic personnel should review all topics in the chapter for relevant material when initiating any design task.*

11.0 RENOVATIONS/UPGRADES

- A. Bring existing systems into compliance with current codes and requirements in the ESM when renovation or other upgrade work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement value¹¹ of the existing system or subsystem¹², and consider upgrading whenever safety is an issue.
 - a. This requirement applies on a system or subsystem basis (e.g., an HVAC system or train of one, a structure, an electrical distribution system, etc.).
 - b. Systems and subsystems are listed in Section 210 of Chapter 1 of the ESM.
 - c. The Chapter 1 and most-affect-discipline POC is the authority having jurisdiction for determinations on this requirement.

12.0 SPECIFICATIONS

- A. CSI-format specs adequately describing the work shall be prepared by the Design Agency and followed by the Contractor whenever any of the following criteria are met:
 - 1. The work is ML-1 or ML-2.
 - 2. The estimated construction cost is \$300k or more.
- B. Both the Chapter 1 and ESM POC of the most-affected discipline can grant variance to the above.

- C. When a LANL Construction Specification Manual section applicable to the work exists, it shall be followed (except for the rare case when the ESM chapter refers to it as guidance).
- D. ML-1/ML-2: When LCSM masters are used for ML-1 and ML-2 projects, changes from the master shall be highlighted in drafts using change tracking such as text strike out or gray shadow for removed text and bold for added text. Final, 100% approved specs shall have such revision tracking removed (be plain, clean text). *Guidance: Spec edit tracking is recommended for all projects*
- E. *Guidance: CSI specs are recommended for all projects, and especially when multi-discipline or complex. Very basic projects may be able to capture needed instructions elsewhere (in ECN or DCP instructions, sketches, or drawings).*

13.0 VARIANCES

- A. Requested variances and exceptions to the ESM text (not standard detail/drawing) requirements shall be per [LIR 301-00-02](#), Variances and Exceptions to Laboratory Operations Requirements and [LIR 220-03-01](#), Engineering Standards, and ESM Chapter 1 Section 100. [At time of writing, this required submission to the applicable POC for initial review and approval prior to his forwarding to the Standards Manager, Chief Engineer, and FWO Division Leader]. *Variance to standard details, the Drafting Manual, and the LANL Construction Specifications Manual only require the Discipline POC's approval.*
- B. Variance from DOE contractual requirements (e.g., Work Smart Standards) requires DOE/NNSA approval in addition to requirements above.
- C. When specifically allowed by ESM sections, the graded/tailored application of codes and standards is not considered a variance to the ESM. *When the graded approach is used to define the appropriate methodology for code and standard application, that methodology and rationale should be formally documented and become part of the project design documents. The applicable LANL Engineering Standards POC is the authority having jurisdiction for approval of the form and content of the documentation.*
- C. *Guidance: At time of writing, ESM Chapter 1 Section 100 stated:*

Variances and exceptions are intended for future work. When work has proceeded in violation of the Engineering Standards, a nonconformance report (NCR) is the appropriate document for dispositioning the situation and shall be submitted by the petitioner. [Project Management Div Procedure 0313, Nonconformance Reporting](#), can be used when more appropriate procedures/forms do not exist.

Z1020 QUALITY REQUIREMENTS

Not used

Z1030 TEMPORARY FACILITIES

Not used

Z1040 PROJECT CLOSEOUT

- A. At the completion of projects, transmit drawings, specifications, and other project records to FWO Document Control & Records Management (DC&RM), M703, at TA-3-410 (becoming TA-63-TBD) in accordance with LANL Construction Specification 01720, Project Record Documents (or project-specific spec section with equivalent or superior requirements).
- B. For drawings, follow additional requirements for transmittal in the LANL Drafting Manual.

ENDNOTES:

Note: EMref refers to a Standards Team internal filing system for hard-to-find references.

- 1 LIR 220-03-01, Engineering Standards.
- 2 FWO Calculation No. 00-00-CALC-M-0003.
- 3 The WSS requires that LANL follow New Mexico Regulations: "Requirements of applicable federal, state, and local laws and regulations that address environment, safety, and health." The New Mexico Engineering and Surveying Practice Act, paragraphs 61-23-3.E, 61-23-21, and 61-23-22 define the practice of engineering and establish qualification and performance requirements for registered professional engineers as a matter of public safety.
- 4 Memo from Lab Counsel to Tobin Oruch, 7/19/01 (EMref-3).
- 5 Basis: Anticipating decision on Letter, Othmer to Forrester, 11/17/03, in January 2004. EMref -15
- 6 Memo from T. Oruch to M. Koop dated 3/14/02 (EMref-4) and [LEM Interpretation No. 2002-02, Rev. 0.](#)
7. The requirements identified within the Environmental Considerations section are "Good Engineering Practice" and must be established for Safety-Related systems to ensure that the environment in which the systems will be placed is conducive to the performance attributes of the selected I&C components. DOE G 420.1-1, Section 5.1.1.3, establishes the requirement for Environmental Qualification as deemed necessary to ensure reliable performance of a safety system under those conditions and events for which it is intended.

The requirements and guidance within the section are developed through several standards. ASME AG-1, "Code on Nuclear Air and Gas Treatment," Article IA-4000 – Design Considerations, requires the identification of environmental conditions for safety-related systems. Additional requirements and guidance were developed through several standards that identify environmental conditions that could adversely impact the operability of I&C equipment. These standards establish methods to recognize and classify such environmental conditions. The standards are provided as follows:

- ISA-71.01, "Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity"
- ISA-71.02, "Environmental Conditions for Process Measurement and Control Systems: Power"
- ISA-71.03, "Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences"
- ISA-71.04, "Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants"

- IEEE 1-2000, "Recommended Practice – General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation"
 - IEEE-1159, "Recommended practice for Monitoring Electric Power Quality"
 - IEEE-1100, "Recommended Practice for Powering and Grounding Electronic Equipment IEEE Emerald Book."
8. [LIR/LIG 402-100-01](#), Signs, Labels, and Tags; and 1997 IAPMO UPC, Section 601.2.
 9. 1997 IAPMO UMC, Section 305.
 10. DOE-HDBK-1140, "Human Factors / Ergonomics Handbook for the Design for Ease of Maintenance," Section 4.9.3.6, identifies a maximum usage height of 12 feet for a painter's type stepladder. For Safety-Related systems this represents the minimum height for ease of surveillance and maintainability given the potential apparatus available for the performance activities.
 - 11 Replacement value determined using recognized cost estimating procedures and a national material and labor cost database.
 - 12 This exceeds requirements in the UBC but is necessary to assure that significant renovations to a facility are more than just skin deep. Over time this requirement will bring about upgrades to the underlying *I&C* systems in facilities. This percentage was accepted by the TRB per Minutes from the Facility Engineering Manual Technical Review Board meeting on 7/19/00. Fifty percent is also used in Chapter 7; in the 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations; and for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5.